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CYBERNETICS, COMPUTERS AND AUTOMATION
TECHNOLOGY

REPORTERS VISIT UKRAINIAN INSTITUTE OF CYBERNETICS

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 13 Feb 77 p 4

[Article by N. Pavlenko and V. Rybin: "At the Edge of the Improbable"]

> [Text] Cybernetics does not need to be described. Today even schoolchildren know that it is the science of controlling, communicating and processing information and that the term "cybernetics" in the sense of "helmsmanship" was thought of by the ancient Greek philosopher Plato.
>
> Cybernetics is commonplace in our age.

The head of the department of engineering-physics fundamentals of cybernetics, Vitaliy Pavlovich Derkach, carries many titles--doctor of engineering sciences, professor, Honored Leader in Science.... We mention this as a prologue because we know: Vitaliy Pavlovich is a very busy man and you address him only businesslike questions.

He too began the exchange in a businesslike way. On a table he placed an electric lamp--the symbol of a so-called first-generation computer. Next to appear on the table was a logic cell of a second-generation computer--an oblong roughly matchbox in size, on which were mounted two transistors, two diodes, five resistors and one ferrite transformer. Then side by side with this "engineering wonder of the 60's" was laid a gray plastic oblong half as big as a piece of theater lobby toffee.

"An integrated circuit from a third-generation computer," Vitaliy Pavlovich informed us. "It is equivalent to ten second-generation logic cells in capabilities."

One more object was put on the table, something you could not see without a magnifying glass--a silicon wafer a few square millimeters in size. But this "crumb" equalled several thousand second-generation logic cells.

"Do you know what our microminiaturists are doing? When they draw portraits on poppy-seeds? Well, now, microminiaturists could not cope with this job.

Only the computer itself--specialized, naturally--could produce the circuit on this basic component of a fourth-generation computer. Following a specified program."

"But how does it do it?" we asked.

"With elionic [electron-ionic] technology. Its development is a priority goal of our department...."

A phone rang, interrupting our conversation.

"We'll pick up a little later," said Derkach....

"A piano is a fine musical instrument. But not everyone can play it. The quality of performance depends on qualifications and talent of the performer ...."

Saying this, Yuliya Vladimirovna Kapitonova, greeted us; she is a senior scientific staff member and deputy head of the department of digital automata theory.

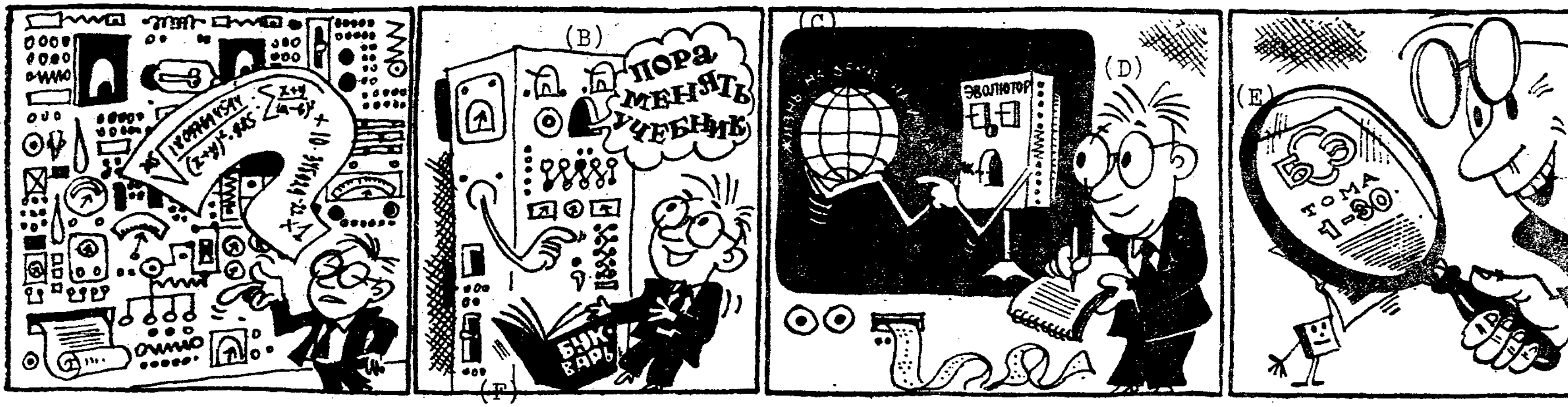
"...And that's just what an electronic computer is. The higher the qualifications and talent the programmer has, the greater the computer's capabilities.... Or take this image: think of a blind foreigner. He has to be blind. Because if he were sighted, then you could explain things to him by gestures. With a computer, just as with a blind stranger, you can talk only in a language he knows.

"In other words, you need a program. But do you know what it means to work up a program? There are no technologies for this, everything depends on the abilities of the programmer. He has to carry in his mind a tremendous amount of information about the object he is working on. He literally has to sense this object. And then starts the hardest part--checking out the program, looking for errors. 'Don't think you'll find the very last error,' programmers keep saying. And they keep on looking. And think about how it would be to simplify this process of program compiling and checkout.

"Once the director of the Institute of Cybernetics, Academician Viktor Mikhaylovich Glushkov, suggested looking at programming as a process of designing. With this phrase that says nothing to the uninitiated started a new direction of work, ending up in a most important discovery; essentially, it amounts to the fact that an automated technology for compiling and checking out programs was developed.

"From automating programming, an enormous advantage to the national economy, the next step was taken--to automating designing. You probably have heard this expression: 'Computer designs computer'? Man of course does the designing. But there is a grain of truth in this popular phrase. Here's an example for you: designing the processor--the most vital part of a computer--earlier took two years for a team of ten. Today, with the design automation system two can draw up the plans for a new processor in 15 hours...."

ОТ ПОКОЛЕНИЯ К ПОКОЛЕНИЮ (A)



Panel: V. Trinchenko

Key: A. From Generation to Generation
B. "Time to Change Textbook"
C. "This is how life began on earth...."
D. "Evolutor"
E. Great Soviet Encyclopedia, volumes 1-30
F. Primer

"...Now here we're teaching the machine to understood simple human speech," said one of the 'teachers,' Candidate of Engineering Sciences Taras Klimovich Vintsyuk.

He walked up to a BESM-6 and pronounced loudly into the microphone:

"Five!"

From the electronic womb one heard, echolike, the muffled voice of the computer:

"Five...."

"Decimal, decimal, comma!" said Vintsyuk.

It seemed as if the assignment was hard for the computer. Tiny lights flickered on the panel, raced one after the other, vanished, then again lit up, but now in a clear inscription. And the computer's voice seemed to be reading the inscription:

"Decimal...decimal...comma!"

"This is not just a simple magnetic tape recorder replay," explained Vintsyuk. "The machine 'understands' what's been said to it."

"Understands everything?"

"Not yet everything. The computer's vocabulary is only 300 words."

Whenever you run into this kind of unusual phenomenon, you are forced to gaze into the future: what's is out there, on another page of the "computer primer"? We found that scientists know this quite well. If, for example, you say the word "doctor," then the computer runs through all the sentences it knows that have the word "doctor" in them. And it turns out that a doctor acts differently in different situations--he eats dinner, treats, walks, stands. And suddenly the computer compares that a table also stands. Does this mean it is the same as a doctor? And the machine asks this of its teacher--man. And it gets back a comment--don't jump to conclusions....

And the day will dawn when man can cope with the machine with his state of being. And the machine is an exceptionally sensitive instrument that "understands" how a person is feeling. And the computer says to the man in a quiet synthetic voice:

"You are tired. Speech modulations are unclear. Plainly, symptoms of a bad night's sleep. Take care of your health...."

"Everything stops moving right at high noon in part of a city at some instant .... Work at establishments halts unexpectedly, as if by magic...."

These lines are from a Belyayev's fantasy novel "Vlastelin mira" [Master of the World], where the hero, aided by an invented "thought irradiator," is able to control the movements of other people.

"Biocurrents form in the human central nervous system--a kind of 'orders' to muscles. Electrical potentials of these biocurrents can be appropriately processed and stored in the computer's memory and then the computer can compel the muscles of another person to precisely reproduce the movements...."

This is one explanation given us by the chief of the bioelectrical control and medical cybernetics department, Leonid Sergeyevich Aleyev.

We saw once more that it is just a step, in the Institute of Cybernetics, from fantasy to reality right now.

Leonid Sergeyevich demonstrated the myoton complex: it is a multichannel instrument for bioelectrical control of movements.

...Two department staffers were placed, facing away from each other, at some distance apart. On their arms were placed electrodes, then these were connected by wires to the instrument. One of the staffers, the "donor," slowly began flexing an arm and glowing snakes squirmed across the screens of the oscillographs. Biocurrents had been recorded. Aliyev rotated a knob, sending signals amplified by the instrument to the "receiver." And an arm of the other staffer slowly began flexing.

"What's this for?" we asked.

"For treating patients. Imagine that someone's arm is paralyzed. This means that his motor centers affected by the disorder cannot send strong enough signals to the muscles. But what if you use biocurrents recorded from a healthy individual?.... Or, let us say, a pilot performs intricate aerial acrobatics. The 'myoton-complex' lets an instructor even on the ground control the motions of the novice-pilot.... Or take industrial training. Right now a foreman is limited to the simple demonstration: 'Do as I do.' But try and suppose you could capture all the subtleties of movement...."

We imagined to ourselves a gymnasium where athletes were working out for a competition. How could the best performance be repeated? But what if a champion's biocurrents are recorded, then transmitted to another athlete?....

In general, in the department of bioelectrical control and experimental cybernetics, one can fantasize to one's heart's content. And everything will be actually feasible.

How did life start on earth? The centuries scientists have been seeking an answer to this query! Staff members of the Institute of Cybernetics have tried to trace the evolution of the simplest living organisms.

...The memory of the evolutor--a specialized computer--was empty, like the world on the first day of creation. And the first, "living creatures"--electrical models of the simplest organisms--settled into it. The "creators" endowed them with 64 possible forms of behavior--the ability to eat, reproduce and assimilate information.... Then "natural selection" began. Generations came and went. Only the most "adapted" survived.

In several hours the machine had traced the course of the evolution of living organisms, where nature had taken millenia. Sixty thousand generations came and went in the "evolutor."

The journey through time could have gone on. If full information about the regularities of how living matter developed was placed in the "evolutor," information about physical processes occurring on life from the time life began, the computer would trace the full evolution from primeval protoplasm to the organization of the brain. But unfortunately science as yet lacks this full information.

...Seemingly, catastrophe was inevitable. Tumbling chaotically, a spacecraft was falling on jagged cliffs of an unexplored planet. And now the craft was able to straighten out, slow its rate of descent and then to land softly on the rugged landscape....

We were able to view this computer-simulated film in the Institute of Cybernetics. The craft was dropping fast, but the computer was faster still and calculated all the parameters of its motion, introduced corrections and translated the digital experimental data into their time and space values and displayed them on a regular television screen.

...Along the field moved an ordinary cart bearing a bright inscription on one side: "Tair," skirted a rut and mounted some gently sloping hillocks. And ahead of it began an overly steep slope. The cart stopped, its swiveling television eye took the measure of the slope and, "understanding" that the cart could not negotiate it, rotated to one side to find a detour past the obstacle. "Tair" was equipped with an elementary "artificial brain" and it picked the road itself....

An experiment we became eye-witnesses to in another laboratory began with this simple command:

"Take the pyramid and place it on a cube!"

The television eye looked over the objects scattered on the floor. A manipulator-arm stretched out to them, picked up the pyramid, grasped it and, on finding the cube, released its fingers.

This resembled the motions of an infant taking its first steps. It is still weak and can do little. But precisely the analogy with the infant convinced us that following these very first actions of the "intelligent-machine" capable not only of picking up, but also recognizing and finding objects, come second and third actions. In fact, children grow this rapidly....

Each laboratory has its own experiments. The future of "thinking machines," their astounding abilities, this is what is being brilliantly traced in each experiment.

And again we enter the department of the engineering-physics fundamentals of cybernetics.

"What have we stopped at?" asks department head Vitaliy Pavlovich Derkach.

"At the elionic technology."

"Elionic technology lets us build the most complex microelectronic circuits--the basic elements of computers," Derkach says. "Without it mass production of ultraminiaturized fourth-generation computers is not possible. What does ultraminiaturization mean to you? In comparison, of course. If a second-generation computer is a cabinet, a fourth-generation computer is a cigarette case. But it's not all a matter of size. Functional capabilities of computers and their reliabilities are an order higher in magnitude, generation by generation."

"And can't you show us what this technology amounts to, in some way?"

Vitaliy Pavlovich opened up the table and laid a large red book in front of us. Written on the cover was: Report of the Order of Lenin Institute of Cybernetics of the Ukrainian SSR Academy of Sciences to the 25th CPSU Congress."

We opened the book and saw one page, all blank.

Only in the middle was a black speck.

The next page was the text... of the spot-report. More correctly, its photocopy enlarged 360,000 times. The text had been recorded on the very same speck, a crystal about a fourth of a square millimeter in size.

"Smallest letters in the world," explained Vitaliy Pavlovich. If you use them to rewrite, for example, the whole Great Soviet Encyclopedia, it would take up no more than a quarter of a typewritten page. But the main point is not even that the text is ultraminiaturized, but that it was recorded with a machine. The text of the report, as usual, had been entered into punched tape. A general-purpose computer itself drew up the program. And another one, a specialized Kiyev-70 digital computer, wrote the text with an electronic beam. That's your elionic technology at work."

This was really the most original report to the 25th CPSU Congress.

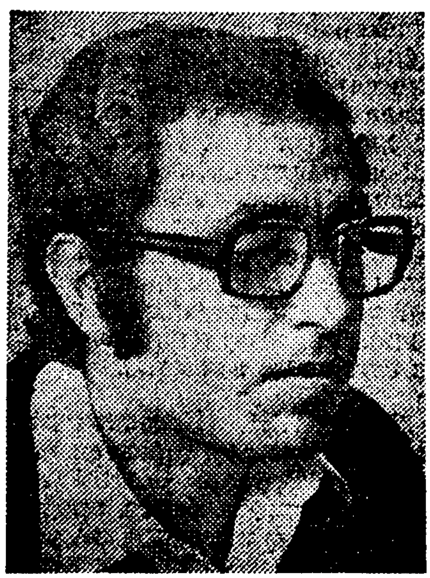
10123
CSO: 1870

TOPICS OF SEMINAR ON ASU's HELD IN ARMENIAN SSR

Yerevan KOMMUNIST in Russian 10 Mar 77 p 2

[Article: "Problems of ASU's Discussed"]

[Text] The All-Union Seminar on Theoretical and Applied Problems of Constructing Automatic Control Systems has concluded its work in Tsakhkadzor. More than 200 scientists representing different institutions and laboratories in the Soviet Union attended this important scientific conference. Our correspondent S. Geoletsyan met with participants in the seminar and asked them to talk about its topic and goals.



Ashik Margarovich Marandzhyan, chairman of the Committee on Cybernetics of the Armenian SSR, and candidate of engineering sciences

"The Committee on Cybernetics was created in Yerevan in 1964. This is a social organization, one of whose goals is to popularize advanced scientific and technical ideas in the area of the theory and practice of cybernetics. The committee also makes possible mutual scientific contacts among specialists. Republic-wide scientific and technical seminars are regularly held, dealing with problems in creating and introducing automatic control systems, hardware, and systems of automatic machinery. These seminars are very useful, since they are excellent training for preparing young scientists. Each year the committee also organizes all-Union seminars or conferences to which leading scientists of the country in the field of cybernetics are invited. The most recent seminar was devoted to theoretical and applied problems in constructing ASU's [automatic control systems]. Five sections worked at it."

"As you know, in recent years much importance has been attached to problems in creating automatic control systems in connection with the growing complexity of managing the national economy and intense development of its industries."

"In our republic ASU's are designed both by individual industries and individual enterprises. Thus, in the field of industrial chemicals work is being done on creating and introducing automatic control systems at the Nairit Scientific Production Association and at the Polivinilatsetat Plant. ASU's are being created at Armelektrozavod [Armenian Electrical Equipment Plant], in the Ministry of Light Industry, and in the Ministry of Industrial Construction. Gosplan's computing center is developing a republic automated control system (RASU). Recently under the auspices of the executive committee of the Yerevan City Council a special laboratory was opened for creating an ASU for the city's financial management."

"The most important work was reported on at the seminar. There it won scientific approval."

Boris Aleksandrovich Aref'yev, doctor of engineering sciences, professor, Leningrad [Photo on preceding page]

"I have followed the work of the young scientists of Armenia involved in cybernetics for a long time. Mention should be made of the fact that in recent years serious changes have taken place in the growth of the republic's scientific potential. As far as I can judge the main questions now interesting Armenian scientists in the field of cybernetics are automatic control systems, computer technology, and software for them."

"Modern manufacturing is unimaginable without the use of automatic machinery in general and automation systems, without the enlistment of computer technology. Just recently I had the opportunity of participating in acceptance of an automatic system for controlling a manufacturing process (ASUTP) in the city of Zyryansk in the Altai Mountains and there I noted with satisfaction that the computing center of this combine was furnished with a number of computers developed and designed in Yerevan. The number of service personnel at this combine was reduced 20 percent and the efficiency of the manufacturing process increased almost twofold."

"Subject matter of this sort, i.e., control of manufacturing processes, was partly reflected in the reports given at the seminar. Special emphasis was placed on the thought that even in branches of industry in which the enlistment of cybernetics was previously not imagined immense combines have been created which are controlled on the basis of algorithms developed by many organizations in the country."

"We listened to reports devoted to constructing control systems in widely different fields of industry (oil refining, electronics)."

"Scientists from different remote areas in the Soviet Union were present at the seminar. There we established business contacts and exchanged ideas on a number of important questions."

Vladimir Nikolayevich Bryunin, doctor of engineering sciences, professor, Moscow [Photo on preceding page]

"Native microelectronics is intimately associated with the radio electronics industry of Armenia. Computers such as the "Nairi" and "Razdan", and others are widely used in processes of designing and manufacturing microelectronic products. On the other hand these computers and automatic machines were constructed on the basis of native integrated circuits. It is therefore no wonder that the symposium on ASU's was held in Yerevan and attracted a wide range of scientists and specialists."

"The subject matter of this scientific conference was exceptionally interesting and topical; it touched on the most burning questions of the day relating to the construction of automatic systems, beginning with their simulation and ending with the practical utilization and efficiency of these systems."

"Computers and complicated measuring units of high quality are not possible by existing methods without enlisting automatic systems. They are used to gather information on the quality of products being developed and manufactured, to analyze defects and the reasons for failure, and to optimize manufacturing processes."

"These facilities are also used to assess the quality of the work of development personnel, technologists, and operators. Introduction of these systems into the daily operation of enterprises of the radio electronics industry will make it possible to raise the quality and reliability of computers and automation hardware."

"In our opinion the prestige of Armenian machine builders will grow even more if they outfit a system for controlling product quality. The scientific manpower of Armenia is oriented toward cyberneticization--the wide use of cybernetics in all spheres of science and technology. This trend, in my opinion, will undoubtedly in the immediate future bring the galaxy of Armenian scientists, and the industry of Armenia along with them, to the forefront among the number of leaders. It is for this reason that I wish to wish success to the scientists, managers of industrial enterprises, and engineering and technical personnel in putting the new technology and ASU's into operation, and especially automatic systems for quality control."

8831
CSO: 1870

EFFICIENT USE OF COMPUTERS: PROPOSAL AND COUNTERPROPOSAL

Efficient Use of Computer Technology

Yerevan PROMYSHLENNOST' ARMENII in Russian No 1, 77 pp 66-68

[Article by A. G. Tavrizyan, engineer and N. Ye. Sarafyan, candidate of engineering sciences]

[Text] Under modern conditions computers become a universal technical base for achieving high efficiency automation in various fields of human activity. In the Tenth Five-Year Plan period, production will increase of universal and control computer complexes, peripheral equipment, devices, installations for recording and transmitting data for automated control systems for technological processes and optimal control in national economy industries. It is planned to increase the output of devices and automation facilities 1.6 to 1.7 times and computer facilities--1.8 times.

At present, the republic has 56 computer centers (VTs) with computers at a total cost of 12 million rubles. The average annual rates in the growth of computers during the Ninth Five-Year Plan period was 18.7 percent. However, in a number of cases, the available capacities of the "Nairi" and "Minsk" computers do not allow for the solving of large economic problems that require specific software. In 1975, in the total volume of machine hours worked by all VTs in the republic, the processing of economic data amounted to only 26.3 percent. By changing over to the use of the third generation series of computers (YeS-EVM) it will be possible to increase the processing of economic data due to their technical improvement.

The most important indicator for computers that reflects the degree of efficient utilization, is the average daily loading which is determined as the ratio of actual time worked to the total time available. Table 1 shows the average daily loading of the basic types of computers in the republic (75.3 percent of the total number).

Table 1

(1) Годы	(2) Среднесуточная загрузка ЭВМ, ч.					
	(3) Для всех ЭВМ	(4) Раздан-2	(5) Наири	(6) Наири-2	(7) Минск-22	(8) Минск-32
1971	6,1	8,1	10,3	6,0	10,2	2,4
1972	6,0	7,6	8,9	5,4	10,9	5,7
1973	6,2	5,2	6,3	5,1	10,4	4,9
1974	5,6	7,6	5,8	6,4	9,6	7,5
1975	5,9	6,9	2,5	5,5	10,9	7,4
(9) Средняя	6,0	7,0	6,8	5,7	10,4	5,6

Key: 1--Years; 2--Average daily loading of computer, hours; 3--For all computers; 4--Razdan-2; 5--Nairi; 6--Nairi-2; 7--Minsk-22; 8--Minsk-32; 9--Average.

As we can see, in the last 2 years, there has been observed a reduction in the average daily loading of the computers in the republic.

One of the reasons for the low computer yield is the reduced planned loadings approved by individual ministries and departments. For example, the norm loading established by the Gosplan and the USSR TsSU [Central Statistical Administration] for the widely used Minsk-22 and Minsk-32 computers is 15 hours per day, while the actual one is 5.6 to 10.4 hours. Such a low level of average loading of the machines is due to the fact that of all VTs and organizations that have computers only 13 to 25 percent work on outside orders which do not exceed 10 to 12 percent of the total volume of work. At present, some enterprises and organizations, where the average daily loading of the computers is 0.7 to 3.5 hours, could do without computers, buying the necessary computer time from such organizations as the RVTs [expansion unknown] the TsSU of the Armenian SSR, the VTs of the Academy of Sciences of the republic etc.

Scattering computers over individual enterprises and organizations and their inefficient utilization lead to great losses and the dispersing of specialists and technical facilities. In the republic 60.7 percent of all VTs have one computer and about 23.2 percent--two computers. It should be noted that this trend is also observed in the country as a whole--60 and 30 percent respectively [1].

The established order of using computers leads to the fact that, on the one hand, the national economy needs additional computer capacities and, on the other hand, the available capacities are not loaded even by half. According to the USSR TsSU data, in 1973, computers in the country were loaded on the average 10.7 hours, while the time of effective loading was about 5.3 hours. Calculations show that by increasing the effective loading of computers by even 50 percent, the need for them would at least be cut in two and the money allotted for them would be reduced by a billion rubles [2].

The organization of the collective use computer centers with a further changeover to a republic network of computer centers would facilitate, to a great extent, the fuller and more efficient utilization of computers. This would make it possible to solve the problem of cadres, eliminate duplication in preparing programs, insure the necessary volume of work for the full loading of the computers, reduce the total cost of the technical facilities and data processing. Moreover, it would become possible to centralize technical servicing and repairs.

Table 2 shows annual computer idle time coefficients in the republic for various reasons.

As we can see, 40 percent in the total structure of losses is due to technical malfunctions of the computers and 29 percent is due to a lack of work. The idle time for other reasons (32.8 percent) is high and is due to the lack of necessary conditions for operating the computers (computer hall, cadres, software etc.).

One of the reasons for the inefficient utilization of computers continues to be the extremely slow rates of changing over computer centers to complete cost accounting, the essence of which is the maximum utilization of all the technical-operational possibilities of expensive computers, i.e., complete repayment of capital investments. It should be noted that the only cost accounting VTs in the republic is the RVTs of the TsSU. The number of customers served by it in 1971-1975 increased 1.9 times. While the work done in 1970 was in the amount of 936,400 rubles; it was 2,467,500 rubles in 1975.

There are serious shortcomings not only in the utilization of computers, but also in the organization of automated control systems. The basic reasons for the lag in the introduction of ASU [Automated Control System] or their inefficient functioning are a lack in experience in developing specialists on ASU, the lack in modern technical facilities for recording, transmitting and processing operational monitoring; the nonobservance of the established stages for developing ASU; the absence of areas for locating the machines, equipment etc.

In our opinion, the organization of a typical design of an ASU on the basis of standardizing design solutions will help correct this situation. According to [2], the estimated cost (unit costs) of creating one ASU is 1.6 to 1.8 million rubles, while with a typical design it does not exceed 0.8 to 0.9 million rubles.

Table 2

Idle time coefficients

(1) Годы	(2) из-за технической неисправности	(3) из-за отсутствия работ	(4) по другим причинам	(5) общий коэффициент
1971	0,037	0,023	0,030	0,090
1972	0,063	0,034	0,025	0,122
1973	0,036	0,031	0,051	0,118
1974	0,055	0,042	0,061	0,158
1975	0,056	0,037	0,038	0,131
Средняя (6)	0,049	0,033	0,041	0,123

Key: 1--Years; 2--due to technical faults; 3--due to lack of work; 4--for other reasons; 5--total coefficient; 6--Average.

The basic way to raise the efficiency of computer operation at the modern stage of development is insuring computer comprehensiveness and interaction on the principles of organizational, technical and methodological unity. The organizational basis of such unity must be a general countrywide government system for gathering and processing data for planning and control, and a technical base consisting of a government network of computer centers. This means the elimination of any duplication of the processed data and the realization of the principle of collective utilization of computers which is responsive, to the greatest extent, to the demands of the socialist planned economy.

In correspondence with the typical method [3], the basic criterion for the technical-economic efficiency of new machines, devices and other objects in the national economy is a minimum cost. As a criterion for the technical-economic efficiency of universal computers, it is expedient to use minimal reduced unit costs calculated on the basis of the unit productivity as a generalized indicator of the scale between individual computer models. This method is reliable for standard computer loading and makes it possible to select the most economically efficient computer model for certain conditions of application. In practice, machines are not loaded equally and, therefore, the use of unit reduced costs per unit productivity increases or decreases, depending upon the organization of computer operation which will reflect on the coefficient of useful utilization of the machine ($K_{нс}$).

Annual losses in the case where the acquired machine is not utilized to its rated capacity may be determined by the following expression

$$\triangle З_{пр \cdot i} = (1 - K_{нс}) \cdot З_{прi};$$

The annual economic effect in the general form when comparing two computers may be determined by formula

$$Э_{j/i} = \left(\frac{C_i + E_н K_i}{П_i}\right) - \left(\frac{C_j + E_н K_j}{П_j}\right) \cdot П_j,$$

where $Э_{j/i}$ is the economic effect of utilizing the j-th computer as compared to the i-th computer, rubles/year;

C_j and C_i are the current (operational) costs for the compared machines;

K_j and K_i are capital expenditures;

$П_j$ and $П_i$ are productivities;

E_H is the norm coefficient of efficiency of capital investments.

The wide utilization of modern economical-mathematical methods and computer facilities will aid in solving in a short time the problems on creating ASU by enterprises and industries, and in the future--by the national economy.

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System Approach to Utilizing Computers

Yerevan PROMYSHLENNOST' ARMENII in Russian No 2, 77 pp 48-49

[Article by Z. Babadzhanov, candidate of engineering sciences]

[Text] In the article by A. Tavrizyan and N. Sarafyan "Efficient Utilization of Computers," printed in issue No 1 of our journal for 1977, the problem of organizing a system of collective utilization computer centers with its further development into a republic network of computer centers was considered along with other problems. We offer for your attention an article by Z. Babadzhanov, candidate of engineering sciences in which he expresses his viewpoint on this problem.

In large and complex systems such as a system for controlling the economy of a republic, the correctness of stating and solving any problem may be determined only from system positions, taking into account the perspectives of the development of this system.

Computers were acquired by enterprises and departments basically for the comprehensive solution of the problem of improving the system for controlling the economy of the republic and of the country. This complex, many-sided and large scale problem is being posed and solved for the first time. Therefore, there are still no developed methodology, no complete study of control systems and no methods for improving plans for systems of various classes.

The attempt to reduce the problem for improving economic control systems to "the use of computers and economic-mathematical methods" met with a lack of success. At the same time, all the shortcomings of the so-called "typical ASU [Automated Control System] plans were discovered"--the lack of goals for improving each concrete subsystem and technical-economic substantiation of the selection of plan solutions etc., which make the development and introduction of such plans inefficient.

It may be seen from this why until now there are still no full-pledged plans for improving subsystems of the system for controlling the economy of the republic, and why the requirements in data processing equipment, in particular, computers with these or other characteristics, have not been determined.

Computers are needed in the processes of developing the methodology of improving and methods for solving problems, as well as for the processes of developing and introducing concrete plans, forming complexes for control problems and solving these problems in the process of system functioning. Obviously, each of these processes presents its own requirements to the properties and the mode of computer application, i.e., it may be that a computer used successfully in the investigation mode may be found unsuitable for solving problems in the system functioning mode.

The development of the methodology for improving and solving economic, data, technical, technological, legal and manpower problems is concentrated basically in computer centers of enterprises and departments.

How purposefully and efficiently these works are carried out are questions needing special discussions, and they are being carried on. Under such conditions, the concentration of computers in some one department will lead to the elimination of computer centers, to destroying the ties between researchers and objects of investigations--enterprises and departments--and, in the final result, will lead to the destruction of the current process of improving the system for controlling the economy of the republic.

A. Tavriz'yan and N. Sarafyan, in their article, "More efficient utilization of computers," and before that B. Melik-Shakhazarov in his article, "A computer for everybody?" consider, apparently, that the above-enumerated problems do not exist or that they have already been solved and that the problem today is reduced to organizing collective use computer centers (VTsKP).

Actually, they are not proposing anything new, since an attempt to organize a VTsKP at the TsNILSU [expansion unknown] was attempted but, as is well known, it ended in failure, because it was found that there were no control problems ready to be given to the VTsKP. The situation has changed little since that time and the authors of the above-named articles can hardly mention problems ready to be solved by computers which are not being solved due to insufficient concentration of computer facilities in the republic.

The authors of the above-named articles demand the changeover of computer centers involved in solving the indicated problems to cost accounting. In this connection, reference is usually made to the TsSU [Central Statistical Administration] experience.

Systems for processing statistical data, gathering and distributing scientific-engineering data etc., are informational systems and do not solve economic control problems; therefore, they were able to avoid the above-named problems. In principle, such systems could determine their computer capacities more precisely in order to accumulate excess capacities; they are not being used for solving nonspecific problems for the system on cost accounting bases.

In my opinion, each system should fulfill its direct functions and it is more expedient to organize a special calculating machine station for outside orders. It may be seen from this that the error by the TsSU should not be represented as an achievement and things should not be demanded from a complex system which is available only to their simpler links. And, finally, a few words about the calculation of the economic effect of using computers cited in the article by A. Tavrizyan and N. Sarafyan. The authors consider that the known method for determining the economic effectiveness of capital investments "makes it possible to choose the most efficient computer model for specific applications" and propose an annual economic effect by comparing two computers.

Obviously, the authors of this article fail to see that computers used in economic control systems, or intended for such use, enter a complex of equipment facilities necessary for the realization of a certain technology of control, and the indicated method is inapplicable to the component of the complex.

The development of full-fledged plans for improving various subsystems of the system for control of the economy of the republic will make it possible to determine very precisely the requirements of properties of various equipment facilities and, in particular, of the productivity, the size of the memory and other computer characteristics. Under such conditions, the computer will be selected uniquely and not by comparing various models.

The effectiveness of expenditures on developing and realizing a plan will be determined by the effect of improving the control of economic processes, by the value of the forecast losses of nonoptimal control, and by the growth in the efficiency of social production.

2291
CSO: 1870

LANGUAGE OF AUTOMATIC CONTROL SYSTEM

Baku VYSHKA in Russian 10 Mar 77 pp 2-3

[Article by F. Kasumov, Assistant Director for Scientific Work of the AzNIINTI (possibly Azerbaydzhan Scientific Research Institute of Scientific-Technical Information), Candidate of the Economic Sciences: "The Language of the Automatic Control System"]

[Text] By the beginning of the tenth five-year plan, 789 automatic control systems for technological processes, 989 for enterprises, and 692 for territorial subdivisions, have been active in the nation. Also, 187 automatic control systems for ministries and departments have been developed, in addition to 121 automatic systems for information processing. In short, a total of 2,778 such systems have been operating.

And our Republic [the Azerbaydzhan SSR] has a significant number of these systems. Recently there was an extended conference of the Republic Interdepartmental Council on the Problems of Improving Management of the National Economy. It was noted that we had made a decided effort to develop and introduce automatic control systems. The first stages of seven automatic systems were put into operation. Now, another 40 are being developed and put to work. The construction of an automatic control system for the Republic and a series of its functional links, together with other such devices, is in progress.

Yes, the tempo of automatic control system growth keeps accelerating each year. However, there are still many problems to be settled in the development of theoretical bases as well as in experimental testing. The solution of a complex of various problems on the assembly, transmission, and processing of information--i.e., the creation of an information system--is an important condition for achieving a unified control system with highly efficient operation. It should be emphasized that the problem of organizing and using the information as well as creating the information systems--i.e., classifiers--is the major problem for automatic control systems of any class.

The information support of the automatic control system includes devices for classification and coding, documentation, standards, indices, and a number of normative materials for regulating the information flow, orders of formation, storage and processing of the data. Let us explain what is meant by classification. It consists of the separation of objects of a certain type into classes in accordance with the basic characteristics of that type of object.

To solve the information support problem of the automatic control system, a number of unified documentation systems and a single system for coding and classification of technical-economic information have been created in the country. These systems are oriented toward direct processing of documents through computer technology.

In the creation of such a system, the problem of devising a single information language for automatic control systems of all levels is solved, duplication of the development of classifiers of the same type is eliminated, their quality is improved, mutual comparisons and a single symbolism for the information are realized, and so on.

One of the component parts of a single system of classification and coding is a combination of classifiers of the technical and economic information. Such classifiers, depending on the problems they solve and their sphere of activity, are subdivided into all-union, industry, republic and enterprise classifiers.

Classifiers used for communications between State management organs and ministries and departments belong to the all-union category. The industry classifiers supplement the all-union ones, containing only the technical-economic information for a specific industry.

Besides these, there are classifiers for the enterprises. The designation of the products of the enterprises, the industries, the ministries, the national economy, and administrative-territorial units as well as data regarding the professions, specialties, jobs, and the like serve as the information for these three management levels. Although this information is in general the same for all levels of management, its volume increases rapidly as the scale of the management increases. Thus, if the type of product and parts used in one enterprise is manufactured in quantities less than tens of thousands, they will multiply to hundreds of thousands in the industry, and in the State scale of material-technical equipment will amount to more than a million varieties.

Classifiers differ from each other not only by their quantitative indices but by their content as well. In the automatic control system of a plant, for example, detailed information on the product manufactured by the plant is required. It is then necessary to code hundreds of product indices such as peculiarities of technical processes in its manufacture, its progress through the various shops in the plant, its type size, the brand of its material, its conformity to the GOST standards, its price, and the like. But the ministry requires more solid information about the product. Even more general characteristics are demanded by the Gosplan or the Central Statistical Administration of the republic.

To solve these and other problems in heightening the efficiency of development and introduction of the automatic control system at all levels, a great deal of work has been done in the years of the ninth five-year plan on the creation of a Unified System of Classification and Coding of Technical-Economic Information (YeSKK TEI) and Unified Documentation Systems (USD).

Much has already been done. The GOSSTANDART of the USSR [expansion unknown] has developed and approved 19 all-union classifiers including Higher Classification Groupings of the All-Union Classifier for Industrial and Agricultural Production (VKG OKP), and 69 industrial sections of the All-Union Industrial Classifier (OKP) with a complete products list. Also developed were 13 unified documentation systems, a combination of organizationa-methodical materials defining the problem, the structure of the YeSKK TEI and USD, their order of priority, their interrelationships, their interaction with the State network of computer centers, and so on.

In our Republic, a number of enterprises and organizations have already become involved in the experience of introducing all-union and republic classifiers, as well as uniform document forms. Let us first note those ministries and departments in which the introduction of classifiers is of all-union importance. They are the Minneftekhimprom [Ministry of the Petroleum Chemical Industry] and the Novo-Baku Petroleum Refining Plant imeni Vladimir Il'ich. To conduct the experiment, they were chosen by the base organization Glavarkhiv USSR [Main Administration of Archives USSR]. The Main Archive Administration of Azerbaydzhan is introducing a unified system of organizational and administrative documentation. Unified documentation complexes can be used for processing by computer devices as well as by traditional manual methods. Some of our departments are already using the Higher Classification Groupings of the All-Union Classifier for Industrial and Agricultural Production, which substantially diminishes the volume of processed information.

We have also developed a design for a consolidated regional production classifier, which should be used to set up the inter-branch balance in the Central Statistical Administration of the Republic.

Improvements have also been planned for other areas. Thus, to provide software for automatic control systems, classifiers of local importance have been designed and introduced. This work has best of all been done in the "Azersel'skhoztekhnika," "Azglavenergo" [Main Power Supply Administration Azerbaydzhan SSR], "Azneft'" [All-Union Trust of the Azerbaydzhan Petroleum Industry], and Minavtotransport [probably Ministry of Automobile Transport] computer centers.

The value of local classifiers is that, connected with an all-union classifier, they can permit transfer from the department, industry or republic levels to the union level without special auxiliary devices or recoding the classifier.

In 1976, our Institute and the All-Union Scientific Research Institute of Technical Information, Classification, and Coding participated in an experimental introduction of the "All-Union Classifier of Standards and Technical Control." During the last two years, the AzNIINTI together with the NIPI "Neftekhimavtomat" [Scientific Research and Planning Institute for Complex Automation of Production Processes in the Petroleum and Chemical Industries] developed a republic classifier for oil equipment based on the "Leninneft'" example. The anticipated economic saving of its introduction for only one RITS of this NGDU [expansion unknown] amounts to 8758 rubles per year. This classifier helps solve such economic problems as current planning and operational control, and may be used in all NGDU of the "Azneft'" and "Kaspmorneft'" [expansion unknown] Associations.

Our Institute has been appointed the chief organization for the introduction of classifiers and documentation systems in the Republic. Since 1975, we have worked on services to users of the all-union classifiers. In the Gosplan of the Republic, a conference was conducted to acquaint users with the order of formulating claims on all-union classifiers, at which representatives of more than 30 ministries and departments were informed of the state of the art of all-union documentation for automatic control systems.

We have developed "Policies of the Republic System for Handling All-Union Classifiers of Technical-Economic Information (RSVOK TEI)," "Instructions on the Registration of Local Classifiers in the Republic," "Instructions in Departmental Control on Handling and Introducing OKTEI [All-Union Classifiers of Technical-Economic Information] and USD in the Republic," and "General Methods of Introducing USD and OKTEI in Automatic Control Systems."

The Institute has organized a republic consultation point to give methodological assistance to designers of local classifiers and base organizations, as well as to leading specialists of ministries and departments, and to operation managers.

Beginning with 1977, we have been registering local classifiers and document forms. In this connection, all ministries (departments) designing and introducing local classifiers and department documentation forms must, no later than the fourth quarter, present materials to the AzNIINTI in conformity with existing instructions. This should not be delayed, for after 1978 the use of unregistered local classifiers and document forms will be forbidden.

It should be noted that the use of all-union classifiers in enterprises and organizations and of the all-union production classifier is properly entrusted to the Central Statistical Administration and the Glavsnab [Main Supply Administration] of the Republic, the chief organizations for handling and developing these classifiers. Work on this has already begun.

For the universal and successful use and introduction of all-union classifiers of technical-economic information and unified documentation systems in the Republic, all associations, enterprises, and organizations as well as ministries and departments of the Republic developing and introducing automatic control systems should actively participate. This is especially important since the most urgent problem is the development and introduction of these systems into the automatic control systems of the highest rank, at the republic, industrial, and State levels.

2612
CSO: 1870

ALL-UNION STATE STANDARD GOST 15125-70, CABLES, WIRING AND CORDS, ELECTRICAL AND AUXILIARY MATERIALS

Moscow GOST 15125-70 KABELI PROVODA SHNURY ELEKTRICHESKIYE I VSPOMOGATEL'NYYE MATERIALY. CHAST' 1 in Russian 1972 pp 305-325

[Booklet by the Committee on Standards, Measures and Measuring Instruments Attached to the USSR Council of Ministers 20 pages]

[Text] Carrier Frequency Polystyrene Symmetrical Communication Cables Insulated in Aluminum Sheathing

> By resolution No. 271, dated 4 March 1970, of the Committee on Standards, Measures and Measuring Instruments Attached to the USSR Council of Ministers, the effective date of the standard is 1 July 1971; in the section on seven-quad cables and in item 1.6 in the section on delivery of cables from 100 to 599 m long of not more than 4 percent, the effective date of the resolution is 1 July 1972. Failure to observe the standard is a violation of the law.

This standard is applicable to carrier frequency symmetrical communications cable with cordel-polystyrene insulation in aluminum sheathing with a protective polyethylene hose, designed for main cable lines and zonal communications lines with frequency range up to 252 kHz (packing of the circuits with K-60 systems) and for connecting lines with frequency range up to 142 kHz (packing of circuits with KRR 30/60 systems), which operate on remote power-supply AC voltage up to 690 V or on DC voltage up to 1,000 V.

Cables are designed for laying by hand and mechanically at temperatures from -15 to +40°C.

Not more than two double bends of the cable in a radius of not less than 15 times the cable diameter in aluminum sheathing is permitted during laying.

Operation of the cables and excess air or inert gas pressure of 4.9-5.9 N/cm^2 (0.5-0.6 kg/cm^2) inside the cable at relative humidity of not more than 15 percent at 20°C is permitted.

The standard corresponds to recommendations on standardization of SEV GS 2253-69.

1. Marks and Dimensions

1.1. The marks and primary areas of application of cables should correspond to those indicated in Table 1.

1.2. Cables of marks MKSAP, MKSAPBP and MKSAPBG should contain one, four or seven quads; cables of marks MKSAPKP and MKSAPB should contain four or seven quads.

1.3. The conducting cores of quads should have diameter of 1.2 mm.

1.4. The thickness of the aluminum sheathing should correspond to GOST 14099-68.

1.5. The dimensions of the protective cable coverings should correspond to those indicated in the appendix of this standard.

1.6. The construction length of single-quad cable should be 830 ± 6 m. Delivery of not more than 10 percent of cable with lengths from 600 to 823 m and not more than 4 percent with lengths from 100 to 599 m of the total length of the consignment shipped to one address is permitted.

The construction length of four- and seven-quad cables should be 825 ± 6 m.

Delivery of not more than 10 percent of cable with lengths from 600 to 818 m and of not more than 4 percent with lengths from 100 to 599 m of the total length of the consignment shipped to the same address is permissible.

Delivery of cable in any lengths is permissible upon agreement of the parties.

Note. Until 1 July 1972, delivery of cables in lengths from 100 to 599 m of not more than 10 percent of the total length of the consignment shipped to the same address is permissible.

1.7. The outer diameters of the cables should correspond to those indicated in Table 2.

An example of the notation of symmetrical high-frequency four-quad cable with cordel-polystyrene insulation in aluminum sheathing, armored with steel tapes with an outer polyethylene hose is: MKSAPBP 4 x 4 GOST 15125-70.

Table 1

Marks of cables	Names	Primary area of application
MKSAP	Symmetrical high-frequency cables with cordel-polystyrene insulation in aluminum sheathing with protective cover consisting of a viscous gluing layer on a base of bitumen and a polyethylene hose	Laying in any soils, in telephone conduit, sewers and tunnels and in regions not characterized by increased external electromagnetic effects (thunderstorm activity, the effect of electrified transport or electric power transmission lines) and by the danger of damage by rodents
MKSAPBP	The same type of cable with steel tape armor with an external polyethylene hose	Laying in any soils, in telephone conduit, sewers and tunnels and in regions characterized by increased external electromagnetic effects (thunderstorm activity, the effect of electrified transport, radio stations or electric power transmission lines)
MKSAPB	The same type of cable, but with steel armor with external covering of cable thread	For the same regions as for cables of mark MKSAPBP, but in soils not characterized by increased corrosion danger with respect to the steel armor
MKSAPBG	The same type of cable with steel tape armor with anti-corrosion coating	Laying in sewers and tunnels and in regions characterized by increased external electromagnetic effects (electrified transport, radio stations or electric power transmission lines)
MKSAPKP	The same type of cable with round steel galvanized wire armor with external polyethylene hose	Laying under water or in soils with heavy tensile forces

2. Specifications

2.1. The conducting cores should be manufactured from copper wire and insulated with polystyrene thread (cordel) applied in an open spiral and with polystyrene tape applied (with overlapping) in the direction opposite the direction of applying the thread.

Table 2

(1) Марки кабелей	(2) Наружный диаметр кабеля с числом четверок					
	1		4		7	
	(3) номи-нальный	(4) макси-мальный	номи-нальный	макси-мальный	номи-нальный	макси-мальный
МКСАП (5)	16,0	18,0	24,2	26,0	28,9	31,0
МКСАПБП (6)	22,4	25,0	31,6	35,0	36,9	39,5
МКСАПБ (7)	—	—	30,6	34,0	35,9	38,0
МКСАПБГ (8)	19,6	22,0	27,1	29,0	32,9	35,0
МКСАПКП (9)	—	—	37,6	41,0	46,3	50,0

KEY:

1. Marks of cables
2. Outer diameter of cable with number of quads, mm
3. nominal
4. maximum
5. MKSAP
6. MKSAPBP
7. MKSAPB
8. MKSAPBG
9. MKSAPKP

2.2. Four cores with insulation of different color should be twisted into a spiral quad with center filler of round polystyrene thread. The lays of insulated cores into quads should be different and should not exceed 300 mm.

2.3. Two cores arranged diagonally in a quad form a working pair. The insulation of the cores of the first quad pair should have red and yellow color and that of the second pair should have blue and green.

2.4. The twisted quad should have colored cotton or synthetic ply applied in an open spiral or tape of synthetic material. The color of the ply or tape in four-quad cables should be: the first (counting) quad should be red, the second (direction quad) should be green, the third should be blue and the fourth should be yellow.

The colors of the plys or tapes of all quads in seven-quad cables should be different, the colors of two adjacent quads -- the counting and the direction quad -- should be red and green, respectively.

2.5. The quads in four- and seven-quad cables should be twisted. The center of four-quad cable may be filled with polystyrene or polyethylene.

Twisted quads of four- and seven-quad cable and the quad of single-quad cable should have belt insulation of six-eight belts of cable paper.

The use of parts of metallized paper belts in belt insulation is permissible.

2.6. An identification-measuring tape on which the trademark of the manufacturer, the year of manufacture of the cable and divisions with numbers which permit determination of the cable length with error of not more than ±0.5 percent should be imprinted not more than every 200 mm under or between the tapes of belt insulation or under the aluminum sheathing.

2.7. The aluminum sheathing should correspond to GOST 14099-68.

2.8. The protective coverings should correspond to those indicated in the appendix of this standard.

2.9. The colors of core insulation in quads should alternate clockwise in the following order in finished cable on the upper end A: red, green, yellow and blue, and the color of the quad ply or tape should alternate from red to green.

The colors on the lower end B should alternate in the same order as on end A, but in a counterclockwise direction.

2.10. End A should be equipped with a valve which permits checking of the air or inert gas pressure inside the cable.

2.11. The electrical characteristics of cable at 20°C should correspond to the values indicated in Tables 3-5.

Deviation of the mean value of the attenuation coefficient from the nominal should not be greater than ±5 mnp/km.

The frequency dependence of the attenuation coefficient for seven-quad cable is matched upon ordering.

2.12. The group should be given to the construction lengths of the cables by the mean values of the working capacitance according to that indicated in Table 6.

2.13. The electrical characteristics of the cables and the tightness of the sheathing and hose after rewinding should correspond to the specifications of this standard.

2.14. The materials used in manufacture of cables should correspond to:

copper wire -- to mark MM according to GOST 2112-62;

polystyrene threads -- GOST 12851-67;

polystyrene film -- GOST 12998-67;

cable paper -- GOST 645-67;

cotton ply -- GOST 6904-70;

polyethylene, measuring tape and metal-coated paper -- to the specifications stipulated in established order.

Table 3

(1) Характеристики	(2) Частота тока в *кгц*	(3) Норма для кабелей с числом четверок			(4) Коэффициент пересчета на другую длину	(5) Методы испытаний	(6) Примечание
		1	4	7			
(7) 1. Электрическое сопротивление жилы в *ом/км*, не более	(8) Постоянный ток	15,85	15,85	15,85	$\frac{L}{1000}$	(9) По ГОСТ 7229—67	—
(10) 2. Омическая асимметрия жил в рабочей паре на длине l в *ом*, не более	(8) То же	0,19	0,19	0,19	$\sqrt{\frac{L}{l}}$	—	(11) Вычисляется по результатам измерений согласно п. 1 данной таблицы
(12) 3. Сопротивление изоляции каждой жилы относительно всех других жил, соединенных с оболочкой, в *Мом·км*, не менее	То же	10000	10000	10000	$\frac{1000}{L}$	(13) По ГОСТ 3345—67	—
4. Испытательное напряжение в *в**: (14)							
а) между всеми жилами и оболочкой (15)	0,05	2000	2000	2000	—	(17) По ГОСТ 2990—67 в течение 2 *мин*	(18) Электрическая прочность изоляции между двумя жилами разных четверок не менее 1500 *в* переменного тока частоты 50 *гц* гарантируется предприятием-изготовителем
б) между жилами в четверках (16)	0,05	1500	1500	1500			

(Table continued on following page)

Table 3 continued

Характеристики	Частота тока в *кгц*	Норма для кабелей с числом четверок			Коэффициент пересчета на другую длину	Методы испытаний	Примечание
		1	4	7			
5. Рабочая емкость в *нф/км* кабелей марок: (19) а) МКСАП, (20) МКСАПБП, МКСАПБ, МКСАПБГ	0,8	25,6±0,8	24,5±0,8	24,0±0,8	$\frac{L}{1000}$	(22) По ГОСТ 10786—64	—
б) МКСАПКП (21)	0,8	—	24,5±1,0	24,0±1,0			
(23) 6. Переходные затухания на ближнем конце между всеми парами в длине 825 *м* четырех- и семичетверочных кабелей и в партии не менее 100 длин по 830 *м* одночетверочных кабелей в *нп*, не менее:							
а) 100% измеренных значений (24)	(26) В диапазоне до 252	6,7	6,7	6,7	$-\frac{1}{2}\ln\frac{L}{l}$	(27) По ГОСТ 10454—63. Активное сопротивление, которым нагружены измеряемые цепи, должно быть равно модулю волнового сопротивления пар при частоте 252 *кгц*	(28) Проверяется на частотах 252 и 150 *кгц*
б) 90% измеренных значений (25)		7,1	7,1	7,1			

(Table 3 continued on following page)

Table 3 continued

Характеристики	Частота тока в кгц	Норма для кабелей с числом четверок			Коэффициент пересчета на другую длину	Методы испытаний	Примечание
		1	4	7			
(29) 7. Защищенность на дальнем конце между всеми парами, в длине 825 *м* четырех- и семичетверочных кабелей и в партии не менее 100 длин по 830 *м* одночетверочных кабелей в *нп*, не менее:							
а) 100% измеренных значений (30)	(32) В диапазоне до 252	7,8	7,8	7,8	$-\frac{1}{2}\ln\frac{L}{l}$	(33) По ГОСТ 10454—63. Активное сопротивление, которым нагружены измеряемые цепи, должно быть равно модулю волнового сопротивления пар при частоте 252 *кгц*	(34) Проверяется на частоте 252 *кгц*
б) 90% измеренных значений (31)		8,3	8,5	8,5			
8. Емкостные (35) связи $K_{2,3}$ и емкостная асимметрия $E_{1,2}$ в партии не менее 25 длин по 825 *м* четырех- и семичетверочных кабелей и в партии не менее 100 длин по 830 *м* одночетверочных кабелей в *пф*, не более:							(36) Значения емкостных связей и емкостной асимметрии для каждой длины должны быть указаны в паспорте

(Table continued on following page)

Table 3 continued

Характеристики	Частота тока в *кгц*	Норма для кабелей с числом четверок			Коэффициент пересчета на другую длину	Методы испытаний	Примечание
		1	4	7			
а) 100% измеренных значений** (37)	0,8	580	570	570	$\frac{L}{l}$	(39) По ГОСТ 10307—62	
б) 90% измеренных значений*** (38)	0,8	230	230	230			
(40) 9. Защищенность на дальнем конце при пробном симметрировании пар внутри четверок без учета эффекта перестановки в партии не менее 25 длин по 825 *м* четырех- и семичетверочных кабелей и в партии не менее 100 длин по 830 *м* одночетверочных кабелей в *нп*, не менее:							
а) 100% измеренных значений (41)	(26) В диапазоне до 252	9,3	9,3	9,3	$-\frac{1}{2}\ln\frac{L}{l}$	—	—
б) 90% измеренных значений (42)		9,8	9,8	9,8			

(Table continued on following page)

Table 3 continued

Характеристика	Частота тока в *кгц*	Норма для кабелей с числом четверок			Коэффициент пересчета на другую длину	Методы испытаний	Примечание
		1	4	7			
(43) 10. Сопротивление изоляции между алюминиевой оболочкой и водой (для кабелей марки МКСАП), броней и водой (для кабелей марок МКСАПБП и МКСАПКП), между алюминиевой оболочкой и броней (для всех бронированных кабелей) в *Мом · км*, не менее	(8) Постоянный ток	10	10	10	$\frac{1000}{L}$	(44) По ГОСТ 3345—67	—

(45)

L — фактическая длина кабеля в *м*. Для кабеля длиной менее 200 *м* при пересчете норм по пп. 6—9 длину следует принимать равной 200 *м*;

l — номинальная строительная длина кабеля в *м* (825 или 830 *м*). (46)

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*Testing at DC voltage of 2,800 V between the cores and sheathing and at 2,100 V between the cores in the quad is permissible.

**A value of capacitive asymmetry $E_{1,2}$ of not more than 700 pF is permissible for 3 percent of the measured values.

***Eighty percent of the measured values of capacitive asymmetry $E_{1,2}$ should not be greater than 230 pF for single-quad cables.

KEY:

1. Characteristics
2. Current frequency in kHz
3. Standard for cables with number of quads
4. Coefficient of recalculation for a different length
5. Test methods
6. Comments
7. Electric resistance of core in ohms/km, not more than
8. Direct current
9. According to GOST 7229-67

(Key continued on following page)

10. Ohmic asymmetry of cores in the working pair at length 1 in ohms, not more than
11. Calculated from measurement results according to item 1 of the given table
12. Insulation resistance of each core with respect to all other cores connected to the sheathing, in Mohms·km, not less than
13. According to GOST 3345-67
14. Test voltage in V*:
15. a) between all cores and the sheathing
16. b) between cores in quads
17. According to GOST 2990-67 for 2 minutes
18. The electric insulation strength between two cores of different quads is not less than 1,500 V AC at frequency of 50 Hz is guaranteed by the manufacturer
19. Working capacitance in nF/km of cables of marks:
20. a) MKSAP, MKSAPBP, MKSAPB and MKSAPBG
21. b) MKSAPKP
22. According to GOST 10786-64
23. The transient attenuation on the near end between all pairs in four- and seven-quad cables 825 m long and in a consignment of 830 m each in lengths of not less than 100 for single-quad cables in np, not less than:
24. a) 100 percent of measured values
25. b) 90 percent of measured values
26. In the range up to 252
27. According to GOST 1045-63. The active resistance by which the measured circuits are loaded should be equal to the absolute value of the wave impedance of the pairs at frequency of 252 kHz
28. Checked at frequencies of 252 and 150 kHz
29. The protection on the far end between all pairs in four- and seven-quad cables 825 m long and in a consignment of 830 m each of not less than 100 m long of single-quad cables in np, not less than
30. a) 100 percent of measured values
31. b) 90 percent of measured values
32. In range up to 252
33. According to GOST 10454-63. The active resistance by which the measured circuits are loaded should be equal to the absolute value of the wave impedance of pairs at frequency of 252 kHz
34. Checked at frequency of 252 kHz
35. The capacitive couplings $K_{2,3}$ and the capacitive asymmetry $E_{1,2}$ in a consignment of not less 25 lengths of 825 m each for four- and seven-quad cables and in a consignment of not less than 100 lengths of 830 m each of single-quad cables in pF, not more than
36. The values of the capacitive couplings and the capacitive asymmetry for each length should be indicated in the certificate
37. a) 100 percent of measured values
38. b) 90 percent of measured values
39. According to GOST 10307-62
40. The protection on the far end at test symmetry of pairs inside the quads without regard to the readjustment effect in a consignment of not less than 25 lengths of 825 m each for four- and seven-quad cables and in a consignment of not less than 100 lengths of 830 m each of single-quad cables in np, not less than
41. a) 100 percent of measured values

(Key continued on following page)

42. b) 90 percent of measured values
43. The insulation resistance between the aluminum sheathing and water (for cables of mark MKSAP) between the armor and water (for cables of marks MKSAPBP and MKSAPKP) and between the aluminum sheating and armor (for all armored cables) in Mohms·km, not less than
44. According to GOST 3345-67
45. L -- the actual length of the cable in m. The length should be taken as equal to 200 m for cable less than 200 m long when recalculating the standards according to items 6-9
46. l -- the nominal construction length of cable in m (825 or 830 m).

Table 4

(1) Частота тока в кгц	(2) Номинальная величина коэффициента затухания в мнп/км при числе четверок в кабеле		(1) Частота тока в кгц	(2) Номинальная величина коэффициента затухания в мнп/км при числе четверок в кабеле	
	1	4		1	[illegible]
10	87	85	150	231	223
20	101	98	200	267	256
30	114	110	250	298	285
40	125	121	300	326	311
50	137	132	350	347	335
60	147	143	400	370	358
70	158	153	450	395	379
80	169	164	500	420	399
90	179	173	550	440	419
100	189	182			

KEY:

1. Current frequency in kHz
2. Nominal value of attenuation coefficient in mnp/km with number of quads in cable

2.15. The cable should be accepted by the technical control of the manufacturer. The manufacturer should guarantee that the cables meet all requirements of this standard.

2.16. The manufacturer is obligated for 5 years from the date of shipment to the customer to replace free of charge failed cable (from coupling to coupling) if the damage occurred due to defects committed by the manufacturer provided that the customer observes all rules of transportation, storage, laying, installation and operation stipulated in the established procedure.

The rules for laying are coordinated with the manufacturer.

The installation instructions are coordinated with the manufacturer or are worked out by the manufacturer.

2.17. The operating life of the cables is not less than 30 years from the moment of delivery to the customer, including the storage time at the

Table 5

(1) Продольные э.д.с. при частоте 50 гц в е/км	(2) Идеальный коэффициент защитного действия металлических покровов кабеля в состоянии поставки, не более, для марок			
	(3) МКСАП		(4) МКСАПБП, МКСАПБ и МКСАПБГ	
	(5) Число четверок			
	1	(6) 4 или 7	1	4 или 7
40	0,85	0,65	—	—
40—150	—	—	0,30	0,33
10	—	—	—	0,24
30	—	—	—	0,17
50	—	—	—	0,11
100	—	—	—	0,11
150	—	—	—	0,12
200	—	—	—	0,14
250	—	—	—	0,16
300	—	—	—	

KEY:

1. Longitudinal emf at frequency of 50 Hz in e/km
2. Ideal coefficient of protective effect of metal coverings of cable in delivery state, not more than, marks
3. MKSAP
4. MKSAPBP, MKSAPB and MKSAPBG
5. Number of quads
6. or

customer's warehouse, provided that the customer observes all rules for transportation, storage, laying, installation and operation of cables stipulated in the established procedure.

Variation of the cable characteristics by the end of the service life is not standardized, but the cables should be efficient.

The actual service life is not restricted to that indicated in this standard, but is determined by the technical status of the cables.

2.18. The cables should be delivered (for installation of their couplings) in a set with the polyethylene tubes and caps which meet the requirements of the technical documentation stipulated in the established procedure. The order and periods of delivery of polyethylene tubes and caps should be coordinated between the manufacturer and customer.

3. Test Methods

3.1. To check the quality, the manufacturer conducts tests of the cables in the quantity and within the deadlines adequate to guarantee their meeting the requirements of this standard.

The check for matching the requirements of sections 1.2, 1.3, 1.6, 2.1-2.6, 2.9 and 2.10 should be made during manufacture or during acceptance-turnover trials on each length of cable.

The check for matching the requirements of section 1.7 should be made not less than once every 24 hours on a single drum with cable of each mark.

3.3. The electrical characteristics should be measured and the voltage insulation should be tested (section 2.11, Tables 3-5), with the exception of measuring the protection on the far end during test symmetry, the insulation resistance of protective coverings applied to armor and the coefficients of attenuation and the protective effect on each length of cable.

3.4. The protection on the far end during test symmetry (Table 3, item 9) should be measured not less than once every 6 months on one lot.

The insulation resistance of protective coverings applied to armor (Table 3, item 10) should be measured not less than once per month on one length of cable of each mark.

The coefficients of attenuation (Table 4) and of the protective effect of metal coverings (Table 5) should be measured not less than once every 3 months and not less than on one length of cable of each mark.

3.5. The stability of the cable characteristics during rewinding (section 2.13) should be checked not less than once every 6 months and not less than on one length of cable of each mark and with a different number of quads.

3.6. If the results of tests conducted on each length (sections 3.2 and 3.3) are unsatisfactory, the corresponding length of cable should be rejected.

If the results of selective tests are unsatisfactory, a double quantity of drums with cable of the same lot should be tested for the same indicator by which the unsatisfactory results were obtained. The results of the repeat tests are final for the given lot.

3.7. The rules and methods of testing indicated in this standard should be used for a control check by the customer.

3.8. The number of quads in the table (section 1.2), the diameter of the conducting cores (section 1.3), the length of the cable (section 1.6), its outer diameter (section 1.7), the application of insulation to the cores (section 2.1), the quad lay (section 2.2), the color coding of the insulation (section 2.3), the presence of quad winding with plys or tape of the corresponding color (section 2.4), the presence of belt insulation tapes (section 2.5), the presence of measuring tape (section 2.6), the arrangement of ends A and B of the cable (section 2.9) and the presence of a valve on end A of the cable (section 2.10) should be checked according to GOST 12177-66.

3.9. The aluminum sheathing (sections 1.4 and 2.7) should be checked and tested according to GOST 14099-68.

3.10. The protective coverings (sections 1.5 and 2.8) should be checked and tested according to the appendix to this standard.

3.11. Measurement of the electric resistance of cores and the ohmic asymmetry (Table 3, items 1 and 2), insulation resistance (Table 3, items 3 and 10), voltage testing (Tables 3 and 4), measurement of the working capacitance (Table 3, item 5), of the transient attenuation on the near end (Table 3, item 6), of the protection on the far end (Table 3, item 7) and of the capacitive couplings and capacitive asymmetry (Table 3, item 8) should be carried out by the standards indicated in Table 3.

3.12. The protection on the far end during test symmetry of the cables (Table 3, item 9) should be measured by using variable resistive-capacitive two-terminal networks and instruments of type VIZ, IKS or others of the same designation and of the same measurement accuracy.

The protection on the far end during test symmetry should be checked in each quad under the effects of the first circuit on the second and of the second circuit on the first independently of each other.

The greatest possible values of protection on the far end in the frequency range up to 250 kHz are added when using variable resistive-capacitive two-terminal networks connected for the check between circuits. The protection should be measured according to GOST 10454-63. Variable resistive-capacitive two-terminal networks should be connected to the jack of the measuring instrument to which the measured circuits are connected during the measurements.

3.13. The attenuation coefficient (item 2.11, Table 4) should be measured by the no-load and short-circuiting method by complete resistance or complete conductance bridges or by other equivalent instruments and methods which permit measurements in the frequency range up to 550 kHz. The measurements should be made on conversational pairs of a single cable length or on several lengths connected in series.

3.14. The ideal protective coefficient of metal-coated cable coverings (item 2.11, Table 5) should be measured on a special measuring installation consisting of an autotransformer, a stepdown transformer designed for secondary winding current up to 200 A at voltage of 1 V and a millivoltmeter which measures voltage within the range of 15-1,000 mV.

The measurements should be made on a cable specimen 1.3 m long. All the elements of the metal coverings of the cable should be soldered on the specimen at a distance of 1 m from each other. Conductors with cross-section of not less than 25 mm^2 and length of not more than 10 cm should be soldered at these points. Potential conductors with cross-section of 5-10 mm^2 and length of not more than 10 cm should be soldered to the aluminum sheathing at a distance of 1.04 m from each other (at a distance of 2 cm from conductors).

The return wire should be two copper busses measuring 20 x 5 mm each arranged strictly in parallel at a distance of 400 mm from the measured specimen. Insulated measuring conductor with cross-section of 25 mm^2 should be placed between the busses.

The return conductor should be connected to the current conductor and the measuring conductor should be connected to the potential conductor on one of the ends of the specimen.

The voltage on the core (or group of cores) should be measured with a millivoltmeter connected between the core (or group of cores) and the potential conductor.

The voltage on the sheathing (numerically equal to the longitudinal emf indicated in item 2.11 of Table 5) should be measured with a millivoltmeter connected between the measuring and potential conductors.

The ideal protective coefficient should be determined as the ratio of the voltage on the specimen core to the voltage measured on the sheathing.

3.15. The stability of the characteristics (section 2.13) should be checked after twofold rewinding of the cable from drum to drum with a neck having a diameter equal to 30 cable diameters for aluminum sheathing.

After rewinding, the electric characteristics of the cable and the tightness of the aluminum sheathing and hose should be checked by the methods indicated in this standard.

4. Packing, Marking, Transportation and Storage

4.1. The cables should be wound on wood drums according to GOST 5151-57 and according to specifications stipulated in the established procedure. The diameter of the drum recess should not be less than 30 times the cable diameter with aluminum sheathing.

One construction length of cable should be wound on the drum.

The turns of the cable should be arranged under the drum sheathing at a distance of not less than 80 mm from the sheathing.

The ends of the cable should be protected against moisture and corrosion: aluminum sheathing should be soldered on the ends and coated with bitumen or oil paint and plastic caps should be attached to the polyethylene hose. Both ends of the cable on drums of type VII and above should be under sheathing.

The lower end of cable not less than 150 mm long on drums of type less than VII should be drawn out through the flange and protected against mechanical damage.

4.2. The cable drum should be accompanied by a cable test report for matching the specifications of section 2.11. The number of the group for the mean value of the working capacitance (section 2.12), the pressure inside the cable at which it was shipped by the manufacturer and the temperature at which it was measured should also be indicated in the report.

The report should be placed in a waterproof envelope which should be attached on the inside of the drum flange under the sheathing in the immediate vicinity of end A of the cable.

The position of the test report and arrangement of end A of the cable should be noted by the word "Certificate" on the outer surface of the drum flange.

The second copy of the report should be sent by main to the customer.

4.3. Cable drums having transient attenuation on the near end of more than 7.5 np should have the notation   7.5 on the outer surface of the flange.

4.4. The following should be indicated on each drum:

the trademark of the manufacturer;

the mark of the cable;

the number of the group for the mean value of the working capacitance in the construction length;

the number of quads;

the length of the cable in meters;

the gross weight in kilograms;

the number of the drum;

the date of manufacture (month and year);

the place of location of end A of the cable and the test report;

the number of this standard.

4.5. Cables should be shipped from the plant and stored and transported under excess air or inert gas pressure of 5.9-10.8 N/cm^2 (0.6-1.1 kg/cm^2) inside the cable on drums with solid board sheathing which protects the cables from the direct effects of sunlight.

4.6. The ambient temperature at which storage of cable is permissible should be within the range from -50 to +40°C.

4.7. The cable should be transported at temperature from -30 to +40°C by any type of transport at any distances according to the rules which provide their safety.

4.8. Cable transport and storage conditions which differ from those indicated in this standard should be coordinated with the manufacturer.

Appendix

1. The protective covering of unarmored cables of mark MKSAP should contain: a viscous adhesive layer on a bitumen base; a polyethylene hose;

2. The bedding of armored cables should contain: a viscous adhesive layer on a bitumen base; a polyethylene hose; tapes of reinforced bitumen-coated paper or impregnated with cable paper; a bitumen composition or bitumen; tapes of reinforced bitumen-coated paper or impregnated with cable paper; and bitumen composition or bitumen.

3. The armor should consist of two steel tapes or of a lay of steel wires; the upper tape should overlap the space between the turns of the lower tape.

4. The outer covering should contain the layers indicated in Table 1.

Table 1

(1) Марка кабеля	(2) Слои наружного покрова					
	(3) Битум или битумный состав	(4) Пропитанная кабельная пряжа	(3) Битум или битумный состав	(5) Покрытие, предохраняющее витки от слипания	(6) Поливинилхлоридная или полиэтиленовая лента	(7) Полиэтиленовый шланг
(8) МКСАПБП	+	—	—	—	+	+
(9) МКСАПБ	+	+	+	+	—	—
(10) МКСАПКП	+	—	—	—	+	+

The "+" sign indicates the presence of an outer covering layer and the "-" sign indicates the absence of this layer.

KEY:

1. Mark of cable
2. Layers of outer covering
3. Bitumen or bitumen composition
4. Impregnated cable ply
5. Coating which protects the turns from adhesion
6. Polyvinyl chloride or polyethylene tape
7. Polyethylene hose
8. MKSAPBP
9. MKSAPB
10. MKSAPKP

5. The thickness of the polyethylene hose should correspond to that indicated in Table 2.

Table 2

мм

(1) Диаметр кабеля по алюминиевой оболочке	(2) Толщина полиэтиленового шланга									
	(3) в защитном покрове кабеля без брони		(4) в подушке				(5) в наружном покрове			
			(6) под ленточной броней		(7) под проволочной броней		(8) поверх ленточной брони		(9) поверх проволочной брони	
	(10) ном.	(11) мин.	ном.	мин.	ном.	мин.	ном.	мин.	ном.	мин.
11—13	2,0	1,5	1,2	0,8	—	—	1,4	1,0	—	—
17—20	2,5	2,0	1,2	0,8	1,5	1,0	2,0	1,5	2,5	2,0
22—25	2,5	2,0	1,5	1,0	1,7	1,2	2,0	1,5	2,5	2,0

KEY:

1. Cable diameter in aluminum sheathing
2. Thickness of polyethylene hose, mm
3. in protective covering of unarmored cable
4. in bedding
5. in outer covering
6. under tape armor
7. under wire armor
8. above tape armor
9. above wire armor
10. nominal
11. minimum

6. The thickness of the protective covering and its elements should correspond to that indicated in Table 3.

Table 3

мм

(1) Диаметр кабеля по алюминиевой оболочке	(2) Защитный покров кабелей марки МКСАП, не менее	(3) Подушка, не менее		(6) Стальная лента	(7) Стальная оцинкованная проволока	(8) Наружный покров, не менее, кабелей марок		
		(4) под ленточной броней	(5) под проволочной броней			(9) МКСАПБП	(10) МКСАПБ	(11) МКСАПКП
11—13	1,7	2,0	—	0,3—0,5	—	1,5	—	—
17—20	2,2	2,0	2,7	0,5	4,0	2,0	2,0	2,5
22—25	2,2	2,2	2,9	0,5	4,0	2,0	2,0	2,5

KEY:

1. Cable diameter in aluminum sheathing
2. Protective covering of cables of mark MKSAP, not less than
3. Bedding, not less than
4. under tape armor
5. under wire armor
6. Steel tape
7. Steel galvanized wire
8. Outer covering, not less than, of cables of marks
9. MKSAPBP
10. MKSAPB
11. MKSAPKP

7. The viscous adhesive layer on the bitumen base should:

be flexible at low temperatures and have a brittle temperature not above -15°C;

have a drop point not less than 50°C;

be corrosion-resistant with respect to the aluminum sheathing, having good adhesion to the sheathing and the polyethylene hose and also provide longitudinal tightness between the aluminum sheathing and the polyethylene hose.

8. The polyethylene hose should enclose the sheathing or armor tightly, should be tight, should not have cracks on the surface and should also not have scratches and dents which project it beyond the range of minimum thickness.

The polyethylene hose of the bedding should be made of stabilized or light-stabilized polyethylene of low density, the polyethylene hose of the outer covering or unarmored cable covering should be made of light-stabilized low-density polyethylene.

9. The breaking strength and the relative ultimate elongation of the polyethylene hose should be not less than 75 percent than that indicated in the standard or the specifications for polyethylene of the corresponding mark.

10. The cable ply and the cable paper should be impregnated prior to application on the cable with an anti-rot composition containing copper naphthenate. The copper naphthenate content in the impregnated cable ply and paper should not be less than 4 percent of the weight of the ply and paper.

11. The bitumen or bitumen composition used in protective coverings should have a softening point not below 45°C and should not flow from the outer coverings at this temperature.

12. The materials used for manufacturing the protective coverings should correspond to:

cable paper -- GOST 645-67;

steel tape -- GOST 3559-63;

steel galvanized wire -- GOST 1526-42;

copper naphthenate -- GOST 9549-60;

polyethylene tape -- GOST 10354-63;

reinforced bitumen-coated paper -- GOST 10396-63;

polyvinyl chloride tape, bitumen or bitumen composition and polyethylene -- to the specifications stipulated in the established procedure.

13. Matching of the specifications of sections 1-3 (with the exception of overlap of the armor gaps) and of sections 4-6 and 8 (with the exception of hose tightness) should be checked on each length of cable according to GOST 12177-66.

14. Matching of the requirements of sections 3 (in the part of armor overlapping), 7 and 9-11 should be checked by the manufacturer on cable specimens in the quantity and within the deadlines sufficient to guarantee matching of the protective coverings to the specifications of the indicated sections, but not less than once every 6 months.

15. Overlapping of the armor gaps (section 3) should be checked by bending a section of cable 1 m from its end around a cylinder equal in diameter to 15 times the cable diameter. The upper armor tape should not reveal gaps between the turns of the lower tape in this case.

16. The flexibility of the compound from which the viscous adhesive layer (section 7) is manufactured should be checked according to GOST 11507-65 and the drop point should be checked according to GOST 6793-53.

17. The adhesion, longitudinal tightness and anticorrosion properties of the viscous adhesive layer (section 7) should be checked on a specimen of cable not less than 1.5 m long freed of all coverings above the hose on the aluminum sheathing.

Four holes should be drilled in the hose at a distance of 100 mm from each other along the length of the specimen; the hose should be arranged around the circumference at an angle of 90° to each other. The diameter of the holes for single-quad cable should be 5 mm and that for remaining cables should be 10 mm.

The adhesive layer should be completely removed from the surface of the aluminum sheathing on sections from which the hose is removed.

A U-shape should be given to the specimen and it should be placed in a bath containing a 1 percent solution of sodium sulfate.

The ends of the specimen should be above the surface of the solution; that part of the specimen on which the holes were drilled in the hose should be completely submerged in the solution; the depth of submersion is not less than 500 mm.

The negative pole of the DC voltage source should be connected to the aluminum sheathing and the positive pole should be connected to the metal plate placed in the solution: the voltage should be 100 V. The specimen should be in the solution for 100 ± 2 hours. The current during the entire test period should be maintained constant by using a resistor (approximately 10 kohms).

The specimen should be removed from the solution and the polyethylene hose together with the adhesive layer should be removed.

There should be no traces of corrosion visible to the naked eye at a distance of more than 5 mm from the section corresponding to the drilled hole in the hose on the aluminum sheathing for single-quad cables and at a distance of 10 mm for four- and seven-quad cables.

18. The tightness of the polyethylene hose (section 8) applied to the aluminum sheathing should be tested on each length of cable; the tightness of the polyethylene hose applied above the armor should be tested on not less than one length of cable and not less than once per month.

The cable should be placed in water with temperature of 20 ± 10°C with one end emerging from the water and the other end reliably sealed or removed from the water.

The cable should be aged for 3 min at DC or AC voltage with frequency of 50 Hz, applied between the metal coverings (sheathing or armor) and the water, after staying in the water for 1 hour.

The voltage should correspond to that indicated in Table 4.

Table 4

(1) Номинальная толщина полиэтиленового шланга, мм	(2) Напряжение постоянного тока, кв	(3) Напряжение переменного тока, кв
1,2	8,0	5,7
1,4—1,7	10,0	7,2
2,0—2,5	12,0	8.6

KEY:

1. Nominal thickness of polyethylene hose, mm
2. DC voltage, kV
3. AC voltage, kV

19. The breaking strength of the hose and its ultimate elongation (section 9) should be checked according to GOST 12180-69.

20. The copper naphthenate content in the cable ply (section 10) should be determined not less than once every 3 months on one length of cable according to the following procedure.

The cable ply removed from the cable should be cut into small pieces, from which two portions weighing 5 g each should be taken. One portion should be placed in a porcelain crucible with capacity of 40-50 ml, slowly burned in a muffle furnace and roasted for 20-30 min. The residue in the crucible should be dissolved in 10 ml of warmed nitric acid (1:1), should be transferred to a vessel with capacity of 200-300 ml, an additional 10 ml of nitric acid (1:1) should be added to it and it should be boiled until complete dissolution of the cupric oxide. The solution should be diluted with water, filtered, flushed 6-8 times with distilled water, acidified with nitric acid, after which the copper content should be determined by electrolysis.

The other portion of the cable ply should be extracted with benzene or chloroform for 8-12 hours in an extraction apparatus until the bitumen composition is completely removed; it is then dried and weighed.

The copper naphthenate content (X) is calculated in percent by the formula:

$$X = \frac{a \cdot 100 \cdot 12}{b \, . \, \kappa},$$

where a is the weight of the copper on the electrode in g; b is the portion of cable ply taken to determine the copper, in g; and k is the ratio of the weight of the extracted ply to the weight of the initial portion.

The copper naphthenate content in the cable paper should be determined after it has been impregnated with an anti-rot composition prior to application to the cable and should be guaranteed by the cable manufacturer.

21. The test for nonleakage of the bitumen or bitumen composition (section 11) should be made on a cable specimen 200-250 mm long.

A specimen of cable wound from the ends with rubber or plastic tape should be held in a horizontal position in a thermostat for 4 hours at 45°C. The bitumen or bitumen composition should not leak out in this case.

Replacement

GOST 12180-68 is effective instead of GOST 12180-66.

Developed by the Plant "Moskabel'": director Ye. Ya. Bankov, topic supervisor Candidate of Technical Sciences R. M. Lakernik and executives Yu. Ye. Gleykh and V. V. Shatalova.

Introduced by the Ministry of the Electrotechnical Industry of the USSR: member of the board Yu. A. Nikitin.

Prepared for ratification by the Department of Electrical Engineering of the Committee on Standards, Measures and Measuring Instruments Attached to the USSR Council of Ministers: department head Candidate of Technical Sciences G. S. Plis and senior engineer V. M. Belova.

By the Department of Electrical Engineering of the All-Union Scientific Research Institute of Standardization (VNIIS): department head A. S. Yelistratova, chief of cable section Candidate of Technical Sciences M. G. Gertsenshteyn and chief designer M. N. Kozyreva.

Ratified by the Committee on Standards, Measures and Measuring Instruments Attached to the USSR Council of Ministers on 30 December 1969 (Report No. 225): Chairman of the Scientific and Technical Committee Deputh Committee Chairman B. A. Dubovikov and members of the committee V. K. Grigor'yev, L. L. Akinfiyev and Sh. I. Shmukin.

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